Docket No. 1759.066

REMARKS

Reconsideration of the application and allowance of all claims pending herein are respectfully requested in view of the remarks below. Claims 1-2 are now pending.

Rejections Under 35 U.S.C. § 103:

Claim 1 stands rejected under 35 U.S.C. § 103(a) as being obvious over Japanese reference No. 7-195136 (Mikito).

Claim 1 of the present application recites, inter alia, a method for manufacturing parts that are molded then forged which include one or more recesses, and the method includes creating a foundry preform having one or more pierced or blind recesses or cavities. The preform is transferred to a tunnel furnace to ensure a uniform temperature of the preform. The preform is positioned in a heading die exposed on a press and at least one multi-directional rod is introduced into at least one of a recess and a cavity of the preform. A heading operation is performed on the preform to create a forged preform with the at least one rod being temporarily positioned inside the recess and/or cavity.

Mikito discloses forming a cast molten metal inside a first die to form a pre-forming product which is smaller than the final product desired. The pre-forming product is then put inside a second die having a shape of the product desired and the die is sealed except for openings to allow pressing means to pass therethrough. The pre-forming product is in a semi-solidified state mixed with liquid phase, and the pressing means applies pressure to the pre-forming product to force it to conform to the shape of the interior of the second die. Also, objects may be arranged to protrude into the interior portion of the die to form cavities therein. However, there is no disclosure of a preform being created which has recesses or cavities which is then subjected to a heading operation while having multi-directional rods inserted in cavities previously formed in the preform. Unlike the process in Mikito, the cavities in the foundry preform are formed prior to a forging operation.

Forging is a process by which metal is heated and shaped by plastic deformation by a compressive force as described in an attached hard copy of a web page published at www.efunda.com. In contrast, squeeze casting is a process which combines casting and forging such that metal is formed into a bottom half of a die and pressure is applied to the liquid metal during the solidification process as described in another copy of a web page from

www.efunda.com, attached. This latter method appears to apply to Mikito which has a pre-forming product, but which does not yet include cavities. Pressure is applied to the pre-forming product while objects are placed therein to form cavities or recesses. In contrast, the preform recited in claim 1 includes recesses or cavities and the preform is subjected to forging. Thus, Mikito does not disclose a preform which has a multi-directional rod inserted into cavities thereof and which is then subjected to forging as recited in claim 1. Instead, Mikito discloses objects being inserted into preforming material during a casting process, but there is no disclosure of a forging process after such a casting process, nor multi-directional rods being inserted into cavities of a preform during such a forging process. Accordingly, because Mikito does not identically disclose the elements of claim 1 except for preheating a work piece using a conventional tunnel furnace, as alleged in the Office Action, this claim cannot be anticipated thereby. Accordingly, claim 1 is believed to be allowable.

Claim 2 is dependent upon claim 1 and is believed to be allowable for the same reasons as claim 1 and for its own additional features.

Rejections Under 35 U.S.C. § 102:

Claim 2 stands rejected as being anticipated by Mikito. Specifically, cylinder means 40 of FIG. 6 is alleged to deploy rods 63, 64 of FIG. 8. Because this rejection relies on the § 103 application to the base independent claim 1, this claim is believed to be allowable for the same reasons as claim 1 described above and for its own additional features. Further, because Mikito does not disclose a forging operation, it cannot include a multi-directional rod translation mechanism to allow at least one rod to be positioned temporarily in the foundry preform during such a forging operation, and this claim cannot be anticipated thereby.

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CONCLUSION

It is believed that the application is in condition for allowance, and such action is respectfully requested.

If a telephone conference would be of assistance in advancing prosecution of the subject application, Applicant's undersigned attorney invites the Examiner to telephone him at the number provided.

Respectfully submitted,

Victor A. Cardona

Victor A. Cardona, Esq.
Attorney for Applicant(s)
Registration No. 44,589

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HESLIN ROTHENBERG FARLEY & MESITI, P.C.
5 Columbia Circle
Albany, New York 12203
Telephone: (518) 452-5600
Facsimile: (518) 452-5579

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Introduction

Forging is the process by which metal is heated and is shaped by plastic deformation by suita compressive force. Usually the compressive force is in the form of hammer blows using a powe a press.

Forging *refines the grain structure* and *improves physical properties* of the metal. With proper grain flow can be oriented in the direction of principal stresses encountered in actual use. Grai direction of the pattern that the crystals take during plastic deformation. Physical properties (s strength, ductility and toughness) are much better in a forging than in the base metal, which h randomly oriented.

FORGING PROGRESSION

Sheared Billet

Upset Pancake

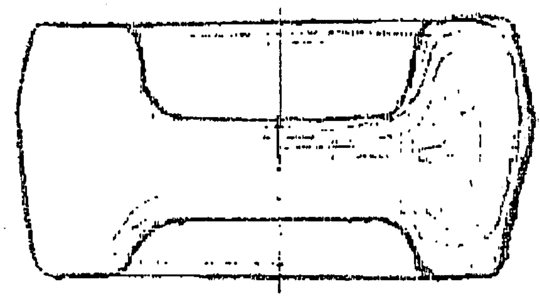
Finished Part

Forgings are *consistent* from piece to piece, without any of the porosity, voids, inclusions and c Thus, finishing operations such as machining do not expose voids, because there aren't any. Al operations such as plating or painting are straightforward due to a good surface, which needs preparation.

Forgings yield parts that have high strength to weight ratio-thus are often used in the design o frame members.

A Forged metal can result in the following

- Increase length, decrease cross-section, called *drawing out* the metal.
- Decrease length, increase cross-section, called *upsetting* the metal.
- Change length, change cross-section, by *squeezing* in closed impression dies. This result grain flow for strong parts



FORGING GRAIN FLOW

Common Forging Processes

The metal can be forged hot (above *recrystallization temperatures*) or cold.

Open Die Forgings / Hand Forgings: Open die forgings or hand forgings are made with rep an open die, where the operator manipulates the workpiece in the die. The finished product is approximation of the die. This is what a traditional blacksmith does, and is an old manufacturir

Impression Die Forgings / Precision Forgings: Impression die forgings and precision forgi further refinements of the *blocker forgings*. The finished part more closely resembles the die in

Design Consideration:

- Parting surface should be *along a single plane if possible*, else follow the contour of the pa parting surface should be through the center of the part, not near the upper or lower edg parting line cannot be on a single plane, then it is good practice to use symmetry of the c minimize the side thrust forces. Any point on the parting surface should be less than 75° principal parting plane.
- As in most forming processes, use of undercuts should be avoided, as these will make the the part difficult, if not impossible.
- Recommended draft angles are described in the following table.

Material	Draft Angle (°)
Aluminum	0 - 2
Copper Alloys (Brass)	0 - 3
Steel	5 - 7
Stainless Steel	5 - 8

- Generous fillets and radius should be provided to aid in material flow during the forging p corners are stress-risers in the forgings, as well as make the dies weak in service. Recom minimum radiuses are described in the following table.

Height of Protrusion mm (in)	Min. Corner Radius mm (in)	Min. Fillet Radius mm (in)
12.5 (0.5)	1.5 (0.06)	5 (0.2)
25	3	6.25

(1.0)	(0.12)	(0.25)
50 (2.0)	5 (0.2)	10 (0.4)
100 (4.0)	6.25 (0.25)	10 (0.4)
400 (16)	22 (0.875)	50 (2.0)

- Ribs should be not be high or narrow, this makes it difficult for the material to flow.

Tolerances:

- *Dimension tolerances* are usually positive and are approximately 0.3 % of the dimension, to the next higher 0.5 mm (0.020 in).
- *Die wear tolerances* are lateral tolerances (parallel to the parting plane) and are roughly Copper alloys to +0.5 % for Aluminum and Steel.
- *Die closure tolerances* are in the direction of opening and closing, and range from 1 mm for small forgings, die projection area < 150 cm^2 (23 in^2), to 6.25 mm (0.25 inch) for la die projection area > 6500 cm^2 (100 in^2).
- *Die match tolerances* are to allow for shift in the upper die with respect to the lower die. based and is shown in the the following table.

Material	Finished Forging Weight Trimmed kg (lb) < 10 (< 22)	< 50 (< 110)	> 500 (> 1100)
	Die Match Tolerance mm (in)		
Aluminum, Copper Alloys, Steel	0.75 (0.030)	1.75 (0.070)	5 (0.200)
Stainless Steel, Titanium	1.25 (0.050)	2.5 (0.100)	6.5 (0.260)

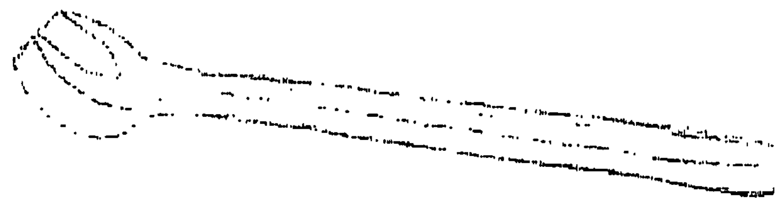
- *Flash tolerance* is the amount of acceptable flash after the trimming operation. This is we and is shown in the following table.

Material	Finished Forging Weight Trimmed kg (lb) < 10 (< 22)	< 50 (< 110)	> 500 (> 1100)
	Flash Tolerance mm (in)		
Aluminum, Copper Alloys, Steel	0.8 (0.032)	3.25 (0.125)	10 (0.4)
Stainless Steel, Titanium	1.6 (0.064)	5 (0.2)	12.5 (0.5)

A proper *lubricant* is necessary for making good forgings. The lubricant is useful in preventing workpiece to the die, and also acts as a thermal insulator to help reduce die wear.

Press Forgings: Press forging use a slow squeezing action of a press, to transfer a great am compressive force to the workpiece. Unlike an open-die forging where multiple blows transfer compressive energy to the outside of the product, press forging transfers the force uniformly t the material. This results in uniform material properties and is necessary for large weight forgi made with this process can be quite large as much as 125 kg (260 lb) and 3m (10 feet) long.

Upset Forgings: Upset forging increases cross-section by compressing the length, this is usec heads on bolts and fasteners, valves and other similar parts.



FORGING--EXAMPLE

Roll Forgings: In roll forging, a bar stock, round or flat is placed between die rollers which rei cross-section and increases the length to form parts such as axles, leaf springs etc. This is essi of *draw forging*.

Swaging: Swaging - a tube or rod is forced inside a die and the diameter is reduced as the cy is fed. The die hammers the diameter and causes the metal to flow inward causing the outer d tube or the rod to take the shape of the die.

Net Shape / Near-Net Shape Forging: In net shape or near-net shape forging, forging resu of material in the form of material flash and subsequent machining operations. This wastage ca as 70 % for gear blanks, and even 90+ % in the case of aircraft structural parts. Net-shape an shape processes minimize the waste by making precision dies, producing parts with very little (less than 1°). These types of processes often *eliminate or reduce machining*. The processes a *expensive* in terms of tooling and the capital expenditure required. Thus, these processes can I justified for current processes that are very wasteful where the material savings will pay for th increase in tooling costs.

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Squeez

Introduction

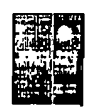
Squeeze casting, also known as **liquid metal forging**, is a combination of casting and forgir

The molten metal is poured into the bottom half of the pre-heated die. As the metal starts soli upper half closes the die and applies pressure during the solidification process. The amount of applied is significantly less than used in forging, and parts of great detail can be produced. Cor used with this process to form holes and recesses. The porosity is low and the mechanical prop improved.

Both ferrous and non-ferrous materials can be produced using this method.


Metals Handbook , Rev. ed., *by Davis, J.R. (ed.)*


Manufacturing Processes for Engineering Materials , 3rd ed., *by Kalpakjian, S.*


Engineering Materials: Pr Selection , 5th ed., *by Bu Budinski, M.K. (ed.)*